ON THE DIURNAL ADVERTISEMENT CALL FREQUENCY OF *HEMIDACTYLUS FRENATUS* WITH ADDITIONAL REMARKS ON THE DISTRESS CALL AND CHURR CALL

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Various aspects of the bioacoustic behaviour of *Hemidactylus frenatus* were studied in November 2007 in Aluthgama, Western Province, Sri Lanka. Markedly increased production of advertisement calls was noted about 30 to 50 min prior to sunset or about 70 to 90 min prior to complete darkness; and during most nights (n=8), peak calling activity was observed during dusk from 1750-1830 hrs, between sunset and complete darkness. Advertisement call activity was found to be much reduced during nights with prolonged rain in comparison to nights without rain, and the difference was statistically significant ($P<0.05$). Minimum number of calls within 7 hours recording was 59 on a rainy night and 208 during a dry night. Average number of advertisement calls on rainy nights was 60.5 (SD=2.12; range: 59-62; n=2), while average number of calls on dry nights was 144.9 (SD=35.7; range: 110-208; n=8). There was statistically significant ($r=0.63$; $P<0.05$) correlation between the number of advertisement calls and average air temperature. The distress call is a short, relatively high-pitched squeak and its average length was 0.041 sec (SD=0.03; range: 0.013-0.080 sec; n=5). Average maximum sound intensity was 89.7 dB (SD=10.69; range: 79.5-105.8 dB; n=5). Maximum sound intensity was reached between 3,967 and 5,443 Hz ($\bar{x}$=4,871 Hz; SD=592; n=5). Maximum recorded frequency was 18,636 Hz, but maximum frequency can be as low as 12,455 Hz with an average of 14,835 Hz. Lowest call frequencies ranged from 554 to 1,199 Hz ($\bar{x}$=904 Hz; SD=287; n=5). The snare-like churr call was structured as a number of 6 pulses. Pulse lengths varied between 0.006 and 0.007 sec ($\bar{x}$=0.0063 sec; SD=0.005; n=6), and time gaps between pulses were 0.021 to 0.026 sec ($\bar{x}$=0.023 sec; SD=0.003; n=5). Churr call length was 0.160 sec and maximum sound intensity was 76.4 dB reached at 5,440 Hz. Minimum and maximum frequency was 369 and 15,869 Hz respectively.

Key words: *Hemidactylus frenatus*, bioacoustics, advertisement call, distress call, churr call, Sri Lanka

INTRODUCTION

For many decades the presence of a voice in geckos has been well-known. However, it was not until 1968 and 1969 when the first analysis of advertisement calls in barking geckos *Ptenopus garrulus* and *P. kochi*, respectively, were carried out by Haacke. Since then advertisement calls have been the subject of research in a number of gecko genera, e.g., *Ptyodactylus* (Frankenberg 1973; Werner *et al.* 1978), *Hemidactylus* (Marcellini 1974, 1977b; Frenkel 2006), *Tarentola* (Nettmann and Rykena 1985) and *Thecadactylus* (Gramentz 2007b). Another gecko call on which bioacoustical research is concentrated is the distress call. Distress call was studied by Frankenberg (1975, 1978), Gramentz and Barts (2004), Gramentz (2004, 2005b, 2005c) and Barts (2006). Brown (1984/85) even noted an ultrasound component in the distress call of many gecko species.

Hemidactylus frenatus is a familiar house gecko species and known to be vocally very active. The advertisement call of *H. frenatus* is well-known and they are even called "*tinktock*" or "*tschicktschack*" (Manthey and Grossmann 1997). The advertisement call of *H. garnotii*, another well known call, is called "*tjik tjak*" in Malaysia (Steck 1908). According to Daniel (1983), the species is perhaps the noisiest of Indian geckos. Territorial advertisement calls are supposed to be the means for spacing themselves out to claim areas for feeding and breeding.

Despite the well-studied structures of the different calls of *H. frenatus* (Marcellini 1974, 1977a) not much is known on its diurnal rhythmicity. Hediger (1934) briefly mentioned that *H. frenatus* not only calls during dusk, but occasionally also during the day. The species was reported by McCann (1940) from Sutgutti, India, to be very vociferous in June and calling frequently at intervals all night. Another mention of the voice of *H. frenatus* stems from Poulin *et al.* (1995), which reported "growl calls" during aggressive interactions.

While describing the different calls of *H. frenatus*, Marcellini (1974) did not name them according to the behavioural context in which the calls were used, but instead differentiated them by their sound effect and number of syllables emitted (e.g. churr call, single chirp call, multiple chirp call). Marcellini (1974) roughly reported that the distress call is very short, < 0.05 sec, and that it begins and ends abruptly. The dominant frequency is approximately 2,000 Hz, with harmonics at 1,000 Hz interval above the dominant frequency. He only published audiospectrograms and these

were very much compressed on the time scale and did not allow a proper call structure analysis. Until now the calls of *H. frenatus* were studied only in subpopulations into which the geckos were introduced by human activities, such as Mexico (Marcellini 1974) and Costa Rica (Frenkel 2006). The present study will show aspects of the species' bioacoustic behaviour in its native environment.

MATERIAL AND METHODS

To evaluate overall advertisement calling activity from one location, Aluthgama, western Sri Lanka (6°25'48.89 N; 79°59'54.35 E), all advertisement calls of *H. frenatus* which could be heard were noted. Recording time was between 1700 hrs and 2400 hrs. Time of dusk, sunset and total darkness was noted. Additionally the air temperature was recorded at 30 min intervals starting at 1700 hrs and ending at 2400 hrs resulting in 15 measurements per night. The digital thermometer was installed with a thermocouple at a height of 2 m. Furthermore, weather and meteorological parameters as clear and overcast sky, rain and thunderstorms were also noted. Recording dates were eight consecutive nights from November 08 to November 15, 2007 and another two consecutive nights on November 23, and November 24, 2007. Judged from the various different directions of which the calls could be heard, they possibly came from about 10-15 male *H. frenatus*.

Additionally five distress calls and a churr call were recorded and analysed. The recording equipment is the same described by Gramentz (2005a, c). The sound card used was Creative Soundblaster Audigy 2 ZS Platinum Pro with a sample rate of 44,100 Hz, 16 bit. Various softwares were used for sound analysis, such as Avisoft-SASLab, Creative WaveStudio and Raven1.2. Air temperatures at which the calls were recorded ranged from 27.6-30.6 °C (Table 1). Distance from the geckos to the microphone while recording churr and distress calls was 5-10 cm.

Terminology was used as in Gramentz (2003, 2008), however, "churr call" was adopted from Marcellini (1974).

RESULTS

Advertisement Call

As previously described by Marcellini (1974) a repertoire of three different call types could be identified in *H. frenatus* in Sri Lanka. The production of these calls was clearly situation dependent. Directly during an aggressive encounter between two males, a short trill-like call can be produced. This "churr call" is emitted when one male chases another in order to drive it away from its territory. Threat and distress calls are emitted in the emotional state of fear.

Table 1: Air temperatures at which advertisement calls of *Hemidactylus frenatus* were recorded at Aluthgama, Western Province, Sri Lanka

Date	$\bar{x}$ (°C)	SD	Range (°C)
Nov. 08, 2007	25.7	1.08	24.5-27.4
Nov. 09, 2007	27.5	1.00	26.1-29.6
Nov. 10, 2007	27.7	1.04	26.3-29.9
Nov. 11, 2007	27.4	1.54	25.0-31.0
Nov. 12, 2007	25.9	1.65	24.4-29.0
Nov. 13, 2007	28.3	1.40	26.3-31.6
Nov. 14, 2007	27.4	2.04	25.0-31.9
Nov. 15, 2007	27.1	1.51	25.4-30.2
Nov. 23, 2007	27.6	1.25	25.9-30.3
Nov. 24, 2007	27.3	1.60	25.9-30.9

Besides night time, *H. frenatus* produces advertisement calls during the day, but comparatively rarely. Calls of this type were noted during daylight at morning (e.g., 0838 hrs), midday (e.g., 1302 hrs), and afternoon (e.g., 1514 hrs) hours.

It showed that calling activity started about 30 to 50 min prior to sunset or about 70 to 90 min prior to complete darkness. During most nights (n=8) peak calling activity was noted precisely at 1750-1830 hrs (Fig. 1b; f to j) between sunset and complete darkness or just before sunset (Fig. 1e), or at complete darkness (Fig. 1a). In just two cases, the calling activity pattern showed a different distribution (Fig. 1c, d). On all days a sharp increase in calling activity could be observed from about 1700 and 1730 hrs onwards. On two consecutive nights of November 10 and 11, 2007 (Fig. 1c, d) the pattern of calling was different from other nights, but similar on these two nights. Here peak calling activity was at about 2115 hrs and 2130 hrs respectively, i.e., a shift of three to three and a half hours in comparison to most other nights.

At times a kind of dynamics in the production of calls can be heard. These may result in short peaks in calling activity. Example, two males respond to the advertisement call of one male, followed shortly by other males in hearing distance. So, occasionally a fairly large number of calls (e.g., 8 calls in 5 minutes) can be heard in a rather short time from different directions. After some time when most males in the vicinity have produced one or two response calls, call frequency is reduced to a lower rate until this kind of escalation pattern repeats. The result is a rather wavy appearance of calling activity during the recording time.

Beside the reaction of replying to an advertisement call there is another situation when such a call is emitted. A number of times I observed that one advertisement call is produced after a male gecko successfully chased away an intruder from his territory. The victorious gecko immediately returned to his territory, formed an arch with its body and emitted a call. Each call is accompanied by a strong exhalation of air from the lungs that can be easily observed from the side.

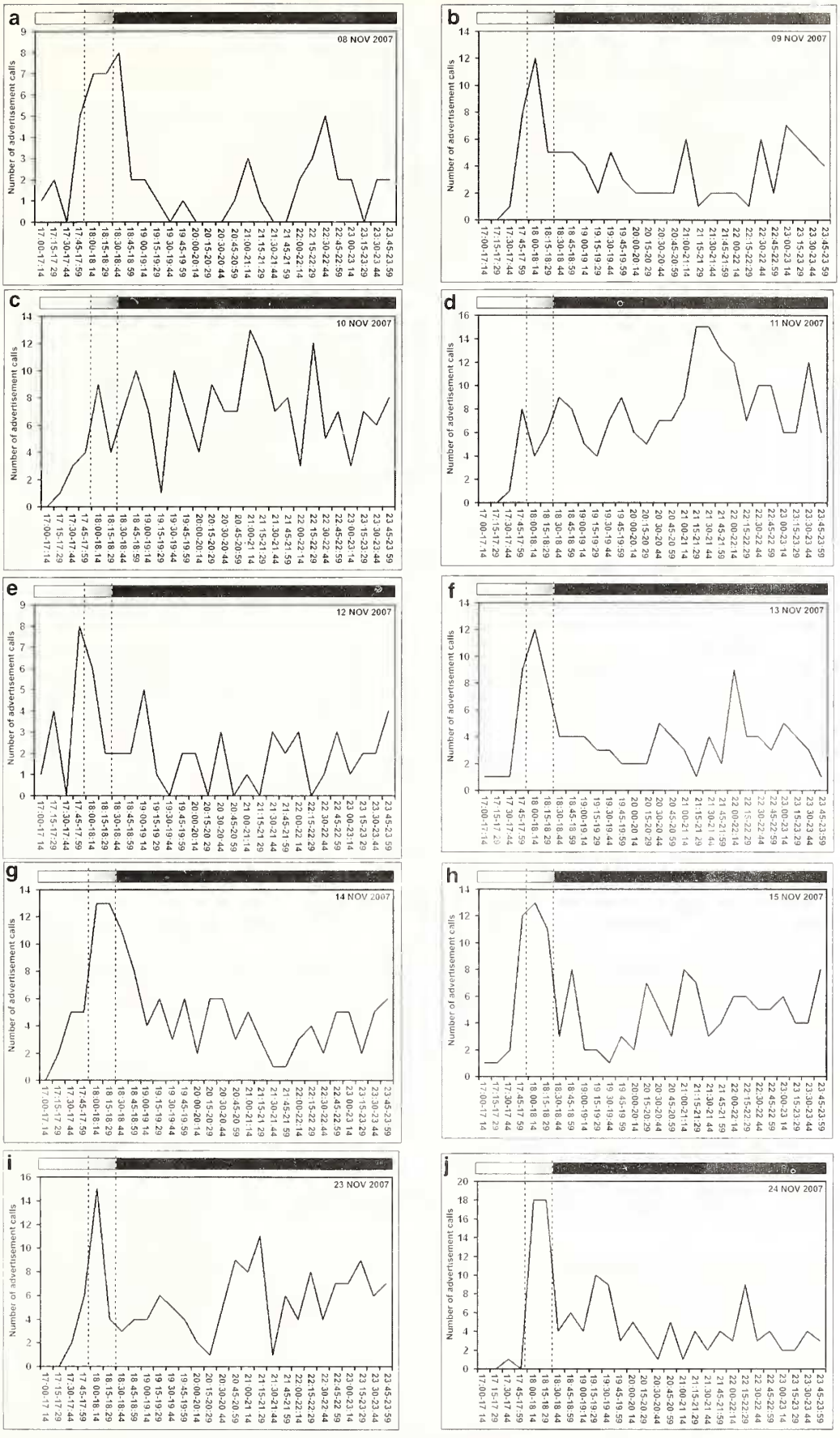

Fig. 1 a-j: Frequency of advertisement calls of *Hemidactylus frenatus* from Sri Lanka during different nights
Left dotted line marks the time of sunset, right dotted line marks point of complete darkness

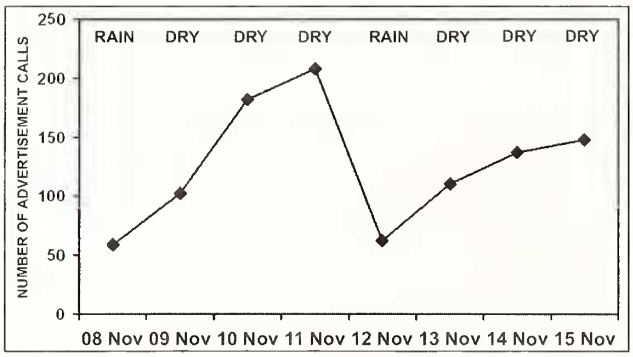

Fig. 2: Variation of the advertisement call activity of *Hemidactylus frenatus* from Sri Lanka during rainy and dry nights

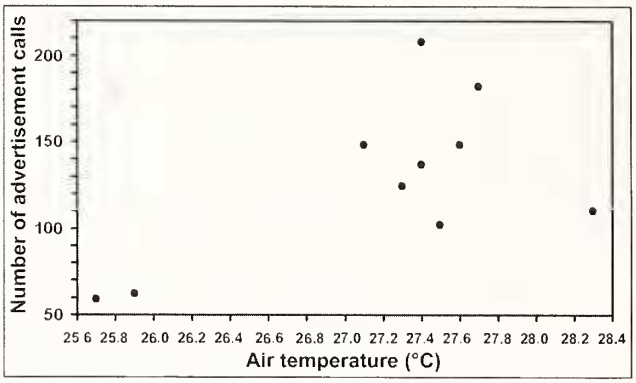

Fig. 3: Relationship between advertisement call frequency of *Hemidactylus frenatus* and air temperature during 10 nights

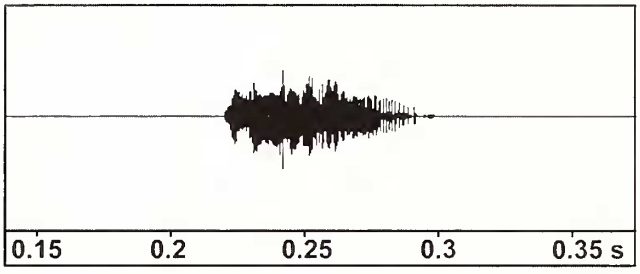

Fig. 4: Oscillogram of a distress call of a male *Hemidactylus frenatus* from Sri Lanka. Length of the call is 0.083 sec

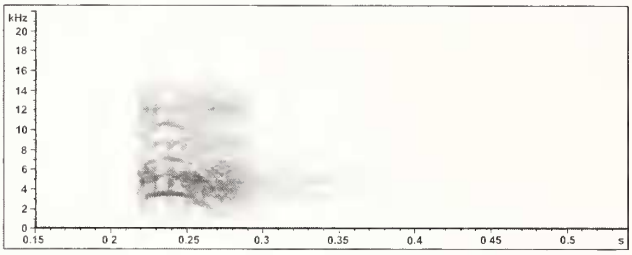

Fig. 5: Audiospectrogram of a distress call of a male *Hemidactylus frenatus* from Sri Lanka. Length of the call is 0.080 sec. The harmonics are at the frequencies 3,414 Hz, 5,351 Hz, 7,012 Hz, 8,765 Hz, 10,425 Hz, 12,086 Hz, 13,898 Hz and 15,592 Hz

Advertisement call activity is very much reduced during nights with prolonged rain in comparison to nights without rain. Minimum calling activity was 59 calls on November 08, during the seven hours recording, of which it was raining for 1 hr 33 min. On November 12, it rained for 1 hr 8 min, and 62 calls were recorded. Maximum number of calls (208) was recorded on November 11, a dry night. Average number of advertisement calls during rainy nights was 60.5 (SD=2.12; range: 59-62; n=2). Average number of calls during dry nights was 144.9 (SD=35.7; range: 110-208; n=8), and there is a statistically significant difference ($P<0.05$; $t=3.197$, t-test) between the means of advertisement calls on rainy and dry nights. Overall average was 128 calls between 1700-2400 hrs in 10 nights.

Call activity seems to be influenced by the weather, since there was increase in calling activity on dry nights with a sharp drop when these were interrupted by a rainy night (Fig. 2). Furthermore, call activity was positively related to air temperature. There was a modest but statistically significant ($r=0.63$, $P<0.05$) correlation between the total number of advertisement calls and average air temperature during the night (Fig. 3).

Distress Call

The distress call is a very short high pitched sound (Figs 4 and 5). The average length of the recorded calls was 0.041 sec (SD=0.03; range: 0.013-0.080 sec; n=5).

Maximum sound intensity varied between 79.5 and 105.8 dB. On an average maximum sound intensity in the five recorded distress calls was 89.7 dB (SD=10.69).

Maximum recorded frequency ranged from 12,455-18,636 Hz, with an average of 14,835 Hz. Lowest call frequencies varied between 554 and 1,199 Hz having an average of 904 Hz (SD=287; n=5). The average of maximum frequency in the five distress calls was 14,835 Hz. Despite the wide frequency span of about 11-18 kHz in the recorded distress calls the span at which the maximum sound intensity is produced covers a rather small range of about 1.5 kHz. Maximum sound intensity was found to be between 3,967 and 5,443 Hz (Figs 6 and 7). The average frequency at which maximum sound intensity was noted was 4,871 Hz (SD=592; n=5).

The distress call of *H. frenatus* shows rather similar intervals between harmonics. The average interval between harmonics of the distress call shown in Fig. 5 was 1,740 Hz (SD=104.2; n=7). The interval between harmonics ranged from 1,660 Hz to 1,937 Hz. Frequency of the lowest and at the same time strongest harmonic was 3,414 Hz. The highest harmonic had a frequency of 15,592 Hz.

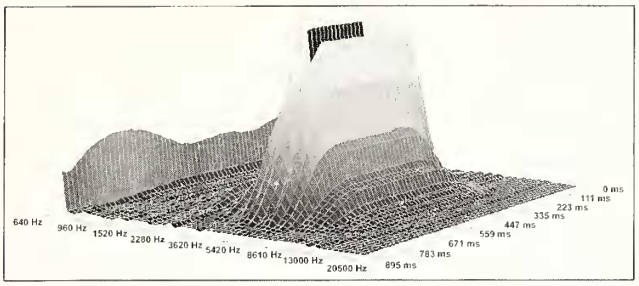

Fig. 6: Three-dimensional logarithmic image of a distress call of individual-a *Hemidactylus frenatus* (male)

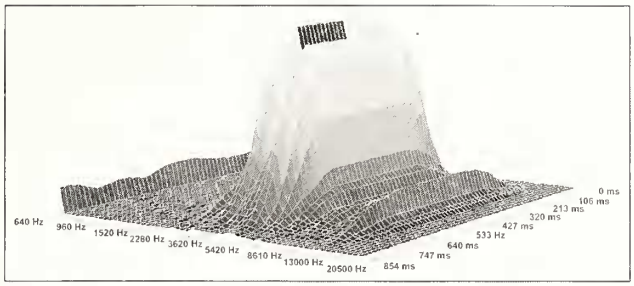

Fig. 7: Three-dimensional logarithmic image of a distress call of individual-b *Hemidactylus frenatus* (male)

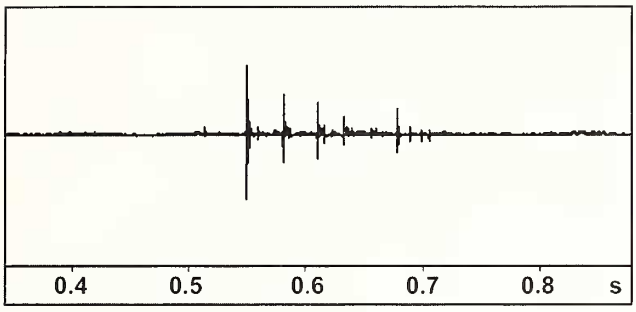

Fig. 8: Oscillogram of a churr call of a male *Hemidactylus frenatus* from Sri Lanka. Length of the call is 0.160 sec

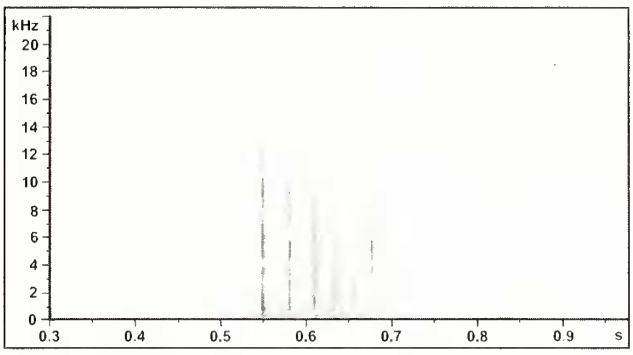

Fig. 9: Audiospectrogram of the same churr call of a male *Hemidactylus frenatus*

Churr Call

The churr call consists of six stronger distinguishable pulses, which can be identified in the oscillogram and audiospectrogram (Figs 8 and 9). The length of a pulse varies between 0.006 and 0.007 sec ($\bar{x}$=0.0063 sec; SD=0.005; n=6). The time gap between these pulses varied between 0.021 and 0.026 sec ($\bar{x}$=0.023 sec; SD=0.003; n=5).

The single churr call had a length of 0.160 sec. Maximum sound intensity was found to be 76.4 dB, which was less than in the weakest distress call. Maximum sound intensity was however reached at 5,440 Hz within the range of the recorded distress calls. The lowest calling frequency was measured in the churr call with just 369 Hz, but maximum frequency of 15,869 Hz was comparable to the range of the distress call.

DISCUSSION

Marcellini (1974) recorded advertisement calls (multiple chirp calls in his terminology) of *H. frenatus* per hour in Mexico during five consecutive nights and condensed the results into one graph. He also noted an increase in calling activity at his starting point at 1800 hrs. However, he observed a steady increase in calling activity in the geckos from Mexico with a peak at about 0330 hrs in the night. The early increase in calling activity around sunset resembles the findings from Sri Lanka, but contrary to the geckos from there, there was no marked peak early after this initial calling activity. Obviously there is a geographical difference in peak calling activity between the two locations. Also in *Ptenopus garrulus* peak calling activity was noted at sunset when darkness increases (Brain 1962). According to Loveridge (1947), *P. garrulus* calls during the short period of twilight. The phenomenon that *H. frenatus* may show different peak calling activities requires further investigation from other geographically different locations.

I have the impression, although this is not yet confirmed by direct observation of a certain individual, that a male may give his first advertisement call just about the same time when it starts activity for the night. Also, Marcellini (1974) reported that after emergence from their diurnal retreats, geckos commonly called before moving to their feeding areas. It is obviously of major importance for the geckos to announce territoriality prior to the start of nocturnal activity. As in this study, Manthey and Grossmann (1997) noted that calls of *H. frenatus* can also be heard during the whole day, and Marcellini (1974) wrote that few calls occur during daylight hours. As in this study, also Frenkel (2006) found that call activity of *H. frenatus* studied in Punta Morales, Costa Rica, was positively correlated to air temperature at night.

Advertisement calls which are formed by a large number of rather identical syllables are known from other *Hemidactylus* species: *H. angulatus* (Gramentz 2005d), *H. mabouia* (Gramentz 2003; Regalado 2003), *H. platyceplialus* (Gramentz

2005a) and *H. turcicus* (Marcellini 1977a; Frankenberg 1982). Furthermore, this rather stereotyped territorial call is known from other genera as *Phyllodactylus* (Marcellini 1977b), *Ptenopus* (Haacke 1968, 1969; Gramentz 2008), *Ptyodactylus* (Frankenberg 1973, 1974), *Tarentola* (Nettmann and Rykena 1985) and *Thecadactylus* (Gramentz 2007b). Multiple chirp calls can, however, also have a submissive function as in *Cosymbotus platyurus* (Gramentz 2007a).

From *H. angulatus* and *H. platycephalus* another call consisting of a large number of syllables is known (Gramentz 2005a, d). This contact call has a rather weak sound intensity and is displayed by the male in close male – female interaction. It would be very interesting to know whether this type of call is also a part of the repertoire of *H. frenatus*.

Marcellini (1974) wrote that the distress call (his single chirp call) is less than 0.05 sec long. In the present study, it showed that this type of call is indeed very short in duration. In fact, the shortest calls were just 0.013 and 0.016 sec long, however, two distress calls had lengths of 0.060 and 0.080 sec. He also noted that some calls can only be heard from a few metres away while others are clearly audible from 10 m. This is reflected in the very different sound intensities of 79.5 to 105.8 dB. Like him, I cannot explain the reason for these variations in sound intensity in the distress call. Distress calls are already known from other gecko species to vary in length. In *Stenodactylus stenurus*, three different distress calls were noted varying mainly in length, but also in sound intensity (Gramentz 2004).

Possibly due to the equipment used by Marcellini (1974) he got the impression of distress calls abruptly beginning and ending. However, as shown in Fig. 3 the intensity increases to a maximum after 0.22 sec. The call ends in a kind of tail in which even single pulses can be identified. In comparison, a distress call actually having an abrupt beginning and ending is for example produced by *Haemodracon riebeckii* (Gramentz 2005b). There are also some differences in the overall frequencies and intervals in the distress calls recorded at Sri Lanka and the data reported by Marcellini (1974) from Mexico. He mentioned as the dominant frequency 2,000 Hz with harmonics at 1,000 Hz intervals. In Sri Lanka, this frequency was higher (3,414 Hz) and the interval between harmonics averaged 1,740 Hz.

According to Marcellini (1974) the churr call is an infrequently heard vocalization and he recorded twice of which both were less than 0.2 sec long. I also recorded this kind of short call duration, having a length of 0.16 sec. He further observed that the churr call was audible from a distance of 35 m. As this type of call was the weakest recorded at Sri Lanka, it is likely that, similarly as in the distress call, a high variation of sound intensity exists. The growl calls reported by Poulin *et al.* (1995) are most probably identical to the churr calls first described by Marcellini (1974).

Only males were found to emit churr and distress calls at Sri Lanka. Marcellini (1974) reported that only males emitted churr calls and this is consistent with the findings of *H. frenatus* at Sri Lanka.

Marcellini's (1974) sound analysis equipment seems to be restricted in detecting frequencies above 8,500 Hz as his graphs of audiospectrograms showed maximum values of 6 or 8 kHz on the y-axis. Therefore, the impression appears that the call frequencies reach their full capacity within this range. This is, however, not the case. Both the churr and distress call reach frequencies above 15 and 18 kHz respectively (Figs 5, 6, 7 and 9).

REFERENCES

BARTS, M. (2006): *Pachydactylus haackei* Haake's Dickfingergecko. *Sauria 28(1)*: 54.

BRAIN, C.K. (1962): A review of the gecko genus *Ptenopus* with the description of a new species. *Cimbebasia 1*: 1-18.

BROWN, A.M. (1984/85): Ultrasound in gecko distress calls (Reptilia: Gekkonidae). *Israel J. Zool. 33*: 95-101.

DANIEL, J.C. (1983): The Book of Indian Reptiles. Bombay Natural History Society and Oxford University Press, Mumbai. Pp. 37.

FRANKENBERG, E. (1973): Vocalizations of the fan-toed gecko, *Ptyodactylus hasselquistii*. *Israel J. Zool. 22*: 205.

FRANKENBERG, E. (1974): Vocalizations of males of three geographical forms of *Ptyodactylus* from Israel (Reptilia: Sauria: Gekkonidae). *J. Herpetol. 8*: 59-70.

FRANKENBERG, E. (1975): Distress calls of gekkonid lizards from Israel and Sinai. *Israel J. Zool. 24*: 43-53.

FRANKENBERG, E. (1978): Calls of male and female tree geckos, *Cyrtodactylus kotschyi*. *Israel J. Zool. 27*: 53-56.

FRANKENBERG, E. (1982): Vocal behaviour of the Mediterranean house gecko *Hemidactylus turcicus*. *Copeia 1982*: 770-775.

FRENKEL, C. (2006): *Hemidactylus frenatus* (Squamata: Gekkonidae): call frequency, movement and condition of tail in Costa Rica. *Revista de biologia tropical 54(4)*: 1125-1130.

GRAMENTZ, D. (2003): Zur Stimme und Rufperiodik von *Hemidactylus mabouia* (Moreau de Jonnès, 1818). *Sauria 25(2)*: 23-28.

GRAMENTZ, D. (2004): Der Schreckruf von *Stenodactylus petrii* Anderson, 1896. *Sauria 26(4)*: 13-16.

GRAMENTZ, D. (2005a): Zur intraspezifischen bioakustischen Kommunikation von *Hemidactylus platycephalus* PETERS, 1854 (Reptilia: Sauria: Gekkonidae). *Gekkota 5*: 155-154.

GRAMENTZ, D. (2005b): Der Schreckruf von *Haemodracon riebeckii* Peters, 1882 (Reptilia: Sauria: Gekkonidae). *Gekkota 5*: 170-178.

GRAMENTZ, D. (2005c): Zum Defensivverhalten und Schrecklaut von *Geckonia chazaliae* MOCQUARD, 1895. *Sauria 27(3)*: 23-27.

GRAMENTZ, D. (2005d): Zur intraspezifischen bioakustischen Kommunikation von *Hemidactylus brookii angulatus* Hallowell, 1852. *Sauria 27(4)*: 41-46.

GRAMENTZ, D. (2007a): Zur akustischen und visuellen Kommunikation von *Cosymbotus platyurus* (Schneider, 1792). *Sauria 29(2)*: 13-20.

GRAMENTZ, D. (2007b): Zum bioakustischen Verhalten männlicher

Thecadactylus rapicauda Houttuyn, 1782. *Sauria 29(3)*: 13-18.

GRAMENTZ, D. (2008): Zum bioakustischen Verhalten von *Ptenopus carpi* Brain, 1962. *Sauria 30(1)*: 43-46.

GRAMENTZ, D. & M. BARTS (2004): Der Schrecklaut von *Pachydactylus rugosus* A. Smith, 1849. *Sauria 26(1)*: 23-26.

HAACKE, W. (1968): A Taxonomic and Ecological Study of the Burrowing Geckos of Southern Africa. Degree Master of Science, University of Pretoria.

HAACKE, W. (1969): The call of the barking geckos (Gekkonidae: Reptilia). *Sci. Pap. Namib Desert Res. Stn. 46*: 83-93.

HEDIGER, H. (1934): Beitrag zur Herpetologie und Zoogeographie Neu Britanniens. *Zool. Jb. Syst. 65(5/6)*: 441-582.

LOVERIDGE, A. (1947): Revision of the African lizards of the family Gekkonidae. *Bull. Mus. Comp. Zool. 98*: 1-469.

MANTHEY, U. & W. GROSSMANN (1997): Amphibien & Reptilien Südostasiens. Natur und Tier – Verlag. Münster. Pp. 235-237.

MARCELLINI, D. (1974): Acoustic behaviour of the gekkonid lizard, *Hemidactylus frenatus*. *Herpetologica 30(1)*: 44-52.

MARCELLINI, D. (1977a): The function of a vocal display of the lizard *Hemidactylus frenatus* (Sauria: Gekkonidae). *Anim. Behav. 25*: 414-417.

MARCELLINI, D. (1977b): Acoustic and visual display behaviour in gekkonid lizards. *Amer. Zool. 17*: 251-260.

MCCANN, C. (1940): A reptile and amphibian miscellany. Part I. *J. Bombay Nat. Hist. Soc. 41(4)*: 742-764.

NETTMANN, H.K. & S. RYKENA (1985): Verhaltens- und fortpflanzungsbiologische Notizen über kanarische und nordafrikanische *Tarentola*-Arten. *Bonn. Zool. Beitr. 36(3/4)*: 287-305.

POULIN, B., G. LEFEBVRE & A.S. RAND (1995): *Hemidactylus frenatus* (House Gecko). Foraging. *Her. Rev. 26(4)*: 205.

REGALADO, R. (2003): Roles of visual, acoustic, and chemical signals in social interactions of the tropical house gecko (*Hemidactylus mabouia*). *Caribbean J. Sci. 39(3)*: 307-320.

STECK, L. (1908): Der Stimmapparat des *Hemidactylus garnotti* Dum. et Bibr. *Zool. Jahrb. 25*: 611-636.

WERNER, Y.L., E. FRANKENBERG & O. ADAR (1978): Further observations on the distinctive vocal repertoire of *Ptyodactylus hasselquistii* cf. *hasselquistii* Reptilia: Gekkonidae). *Israel J. Zool. 27*: 176-188.

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